DIAGNOSTIC MEASUREMENT AS A BASIS FOR PROCEDURE

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About four years ago, the writer was introduced to modern methods of measurement in education and straightway became a conscientious objector to the proposed use of the new ideas. Further study and a closer acquaintance with standard tests and scales led to serious experiments, and these in turn have produced a thorough revision of the theory and practice of her teaching.

Previous to this experience, the writer was in accord with the theory that a good method invariably reduced the variability among members in a class, and tended to produce a closer grouping about a mean or average. This conception fostered the practice of forcing the exceptional pupil to keep pace with his class. Each lesson was gauged to average ability, and extra attention was given to the least capable members of the class. Equality of attainment was recognized as impossible in actual results, but as the end to be aimed at. The progress of the class as a unit was the aim of instruction.

Now, however, it appears that there is a great waste of effort and time in trying to keep a class together. There is no doubt that close grouping is desirable from the point of view of the school system, but if, in realizing this aim, the welfare of the individual pupils is made secondary to the maintenance of a system there is room for improvement.

Divided classes reduce the waste somewhat, but nothing short of individual instruction seems right in theory. The question at once arises, How can such theory be put into practice? Is it not impossible to furnish individual instruction under class-room conditions? The experiments which invalidated theories long held also suggested possible procedures. These were tried out and evaluated according to improvements resulting from their adoption.

A brief report of the work done and graphic records of actual measurements of improvement are submitted. They are evidences of the practicability of individuated instruction under classroom conditions, and show how valuable standard tests and scales are in initiating the new procedures. The present article is confined to a study of reading, but similar changes of method have been found productive in other branches, especially in spelling and arithmetic.

Although the class under consideration consists of but twenty boys, the writer is inclined, from previous experience with much larger groups and mixed classes, to believe that the methods used would be both profitable and practical in such classes as well.

A STUDY OF READING

In October pupils were tested to ascertain the oral- and silent-reading rate of each individual. Five oral and five silent trials were made, and the averages obtained and used as measures of reading rate. The pupils were then asked to read as much as possible in a minute without making any mistakes. With but one exception the rapid readers made fewer mistakes. Comprehension was tested informally. Rapidity and comprehension seemed to go together. Intensive instruction was given. Especial attention was paid to poor readers. After two weeks there was no improvement in the rate of the three poorest readers. The only noticeable improvement was made by the better readers. It was evident that the least capable were getting the least from instruction though receiving more attention. This presented a problem. Why did they fail to improve? They were questioned. Not one of them liked to read. Not one did any reading except when forced to do it. They liked to listen to stories. How could they be reached?

The psychology of reading was studied for possible solutions of the problem. This took time but gradually the following conclusions were reached:

1. There are certainly other phases in the subject than the mere ability to pronounce words suggested by their printed symbols.

2. Perhaps this phase of reading is overemphasized in the lower grades. A great many methods have been devised for use in teaching the mechanics of oral reading, while very little attention

has been given to the reading problem beyond this mechanical stage.

3. The grading of reading material has not introduced new problems but enlarged the elementary problem. The subject-matter is made more difficult, the vocabulary more formidable, and expression requirements are set higher. Nevertheless, the reading is judged largely by its sound. An analysis of difficulties in concrete arithmetic, geography, and history indicates a poor quality of reading which could not be detected by its sound. The results of recent surveys point in the same direction.

4. As the use of textbooks increases through the grades, the ability of children to get *meaning* from the printed page should assume great importance and be the aim of reading instruction. Anything which conditions comprehension is then of value in reading, and whatever methods build up ability in comprehension most rapidly are most economical.

5. No one method is necessarily adapted to all individuals, as there are such diverse causes of failure, but the methods must be based on the psychology of the reading process.

6. The earlier right reading habits are formed, the better for the child. The unit of meaning is the phrase. Therefore it should form the unit of instruction in reading as early as possible.

7. Word study to increase the visual vocabulary is no doubt productive, but extensive reading may have the same effect and be more profitable from other points of view.

8. Interest and attention no doubt condition maximum effort in reading. Good readers should not be asked to keep to the reading pace of struggling readers, as is the case in many oral reading lessons. Keeping the place, when the attention is urging a reader on, causes indolence and works against the formation of worth-while reading habits.

9. Instead of working with one child at a time, while other members of the class wait their turn, reading silently at the oral rate of the child who happens to be reading orally, the members of the class should be grouped, according to their reading defects, into many small groups. Similar groups may be taken together for some lessons, but good readers, who do not need much help with

oral reading, can be profitably employed in improving the quality of their silent reading on new material.

10. A definite diagnosis of individual traits in reading should form the basis of grouping. Every trait which influences reading habits can in turn be influenced by definite training and special practice.

11. Extensive reading must fit the child's present ability and enlist his interest.

The foregoing conclusions formed the basis from which a system of training was devised. Ten types of instruction were planned to cover as many individual needs. The class reader was supplemented by a carefully selected list of books for extensive reading. Methods were devised whereby maximum effort would be called forth and interest sustained. Rate was found to be a measure of improvement which the children could comprehend. They were therefore made aware of their rate of reading and kept graphic records of their individual standings in monthly regrouping tests. "A" readers were those whose rate was more than thirteen lines per minute. They were given the privilege of selecting their own material from the supplementary book shelf for silent reading. This shelf was called "Story Row." The books were arranged in groups according to content. A regular library system was used so that the teacher could ascertain at any time what each child was reading and what he had finished. The quality of the silent reading could thus be revealed by conversation with the pupil. Children who had enjoyed a book were asked to review it for others who might care to read it. Favorite chapters were illustrated. Some children chose informational material. They would recount interesting things which they had learned from their reading, and create a great demand for the book which they had read. No more than two books could be used by a pupil at one time and *stories* had to be finished before another *story* book could be begun.

"B" readers were those whose rate was more than nine lines per minute but not more than thirteen. Pamphlets were provided for their supplementary reading. The material was easier and the content quite suited to their comprehension. Otherwise the system used for the "B" readers was like that for the "A" groups.

They had *less* time for supplementary reading as they required more intensive work with the teacher. Their pamphlets were very popular and were often read by "A" readers.

There was also a group called "C" readers whose rate was between six and nine lines per minute, and another group of "D" readers who read even more slowly and got practically no meaning from the subject-matter. Their supplementary material consisted of separate stories. These they read with the teacher, alternating with her. They liked to have stories read to them. The teacher used her book. The group looked over her shoulder and kept the place, picking up the story and reading on when she stopped, until the end of a paragraph was reached. The meaning was then discussed and the reading continued.

Each child in the class subscribed to a little nature magazine which was kept in the desks for reading during odd minutes. Several other magazines, an atlas, and a file containing good original stories by the children were also at their disposal for this purpose.

The regular reading instruction was the visible means by the aid of which each pupil hoped to get into a group higher than his own by the next measurement.

These groupings were based on rate and were not identical with those made for corrective teaching. The procedures just described together with the intensive teaching in type lessons which follow were jointly responsible for improvements in reading rate and quality. This report would therefore be incomplete if detailed descriptions of methods used to secure the interest of the individual child were omitted.

TYPES OF INDIVIDUATED INSTRUCTION

Type lesson 1.—All look at the first phrase, looking up when they reach a comma or a period. When the entire group is looking at the teacher she nods and they repeat the phrase. She watches individuals to find their difficulties, but does not interrupt. When they have said all but the last word of the phrase they again look down, silently getting the next phrase and looking up, holding the phrase in mind until all are ready. Again the teacher nods and the group gives the phrase orally, looking down at the last word and continuing this procedure to the end of the paragraph or section. The intensive study calculated to improve poor readers can be made to yield a double return, if instead of selecting hard words and subjecting them to analytic study the unit

is the phrase or group of words which expresses an idea. Instead of working at a difficult word, the phrase in which it appears is studied until mastered. Instead of working with one child at a time and giving each child only a few minutes of actual oral reading, four or five of those who have similar ability are grouped together, while other groups of poor readers follow silently. Third-grade material or very simple fourth-grade material is used for this purpose.

While other pupils are being tested the ones who have had Type 1 answer mentally or in writing blackboard questions concerning the material of their lesson. Occasionally duplicated sheets containing uncompleted sentences or a story are used instead, the children filling in the blanks mentally or in writing.

Type lesson 2.—*Eye training* and *focus.* Field of vision enlarged to include several words rather than one. First, by having the book far enough from the eyes. Secondly, by eliminating the use of a finger or other place-keeping device. Thirdly by work with flash cards, flashing phrases, trying to get a phrase at one flash, and counting the number of flashes needed for each phrase. These phrases were cut from current printed matter and mounted on small cards. Written sentences directing children to perform certain activities were also used as flash material. The one who first read the direction carried it out. The one who had three such opportunities in succession was given a sheet with similar work for silent reading and could return to the group when finished.

Type lesson 3.—Silent reading for the purpose of oral reproduction and comprehension.

Type lesson 4.—Silent reading in search of a given phrase, answer, idea, or suggestion in the content of supplementary books, geography text, arithmetic text, and blackboard work.

Type lesson 5.—Differentiation for pupils who confuse similar words or miscall syllables, guess at words, or omit endings. Lists like the following form the basis of such work. Lists are compiled from actual mistakes made by children.

that	woman	beautifully	swimming
when	every	prettiest	board
what	never	prettily	close
then	even	probably	chose
how	ever	lovingly	lying
who	very	companions	buying
their	these	understand	tired
there	those	understood	tried
than	now	laughingly	certain
women	know	quietly	curtain
man	beautiful	left	felt

Type lesson 6.—Lessons in accuracy for those who make errors, substitutions, and omissions; reading a page orally and counting errors, or reading until they make an error to see how many lines they can read perfectly.

Type lesson 7.—Breathing exercises. Children taught to breathe rhythmically at ends of phrases or clauses instead of breaking the smoothness of oral reading. Practice in breath control is thus related to the problem of meaning and interpretation. Abdominal breathing taught.

Type lesson 8.—Articulation exercises for mumblers, or those with other bad speech habits.

Type lesson 9.—Voice work and expression. Unpleasant voice quality and monotony corrected by special practice and training. Children are taught to vary meaning by change of stress and to show relative importance of ideas similarly. Punctuation is studied for the same purpose.

Type lesson 10.—Word study, with difficult words, for ready recognition, pronunciation, and comprehension. Word building and word structure studied.

A blank form similar to the one in Fig. 4 was used during a week of diagnosis. No regular test was used, but methods similar to those used in all available tests were combined in efforts to diagnose each individual. By the end of the week the teacher was able to determine which types of instruction would be needed by each individual. The amount of instruction needed could not be determined until the effects of practice were measured. Four types of instruction could be given in one period by systematic planning.

Aside from the foregoing types of individuated instruction designed for use with small groups, informal dramatization and illustration of parts of reading lessons were given as class exercises. Tableaus and pantomimes were informally arranged from parts of stories. Poems were studied, paraphrased, and read from memory. Words which called up pleasant pictures were selected from descriptive poems. Phrases which were beautiful or pleasing to the ear were used in original sentences.

Beautiful selections from literary masterpieces were read to the children. Interesting incidents from the lives of great men were told, and reading matter provided containing simple biography. Children were taught the use of alphabetical index, table of contents, and cross-references by practice in finding desired information from their own textbooks and by selective reading from magazines.

These varieties of instruction were no doubt of value in securing unflagging interest and active attention. The individual's record was a device calculated to contribute to this end. The purpose of instruction was evident to the child.

Results are appended and may be compared with available data.

Fig. 1 shows the distribution in oral-reading rate during six successive months. The base line represents lines read per minute. The lettered blocks represent individuals. The group divisions are shown by vertical lines. Thus pupil O was in group "D" and read five lines per minute in November, moved to group "C" in December, and was reading nine lines per minute. In January he read twelve lines per minute and was in group "B." In February he read thirteen lines per minute but did not get into group "A" until March. The class median is indicated in each distribution. The reading rate is an average of from three to five trials on as many selections of unstudied material from the Horace Mann reader. No rate of measurement was made in April, as other reading tests were conducted. Fig. 2 gives distributions in silent-reading rate.

The final oral measurement is given in the individual records, which are found in Fig. 3. Here the base line indicated months (November, December, January, February, March, and May). The vertical shows lines read per minute. Each block is the record of the pupil who is designated by the initial. The dotted line in each record is the class median and is inserted for purposes of comparison. Thus pupil J read eleven lines per minute in November and was above the class median. He improved but not as fast as the class, for he fell below the median in December. In January he took his old position above the median by improving in rate of reading and in rate of improvement. At the same time he surpassed the standard set for "A" readers and went on improving without further intensive instruction. The length and shape of the various curves tell their own story.

Fig. 4 shows how much of each type of training was given each individual to produce the improvement. Each type of instruction is indicated at the left. The pupils are designated by letters. Each vertical line indicated about one week of training of a specified type. This means about fifteen minutes a day for four days, not always consecutive. At the bottom of the figure absence is indicated, a horizontal line representing one week of absence. This explains why some poor readers did not receive more of certain

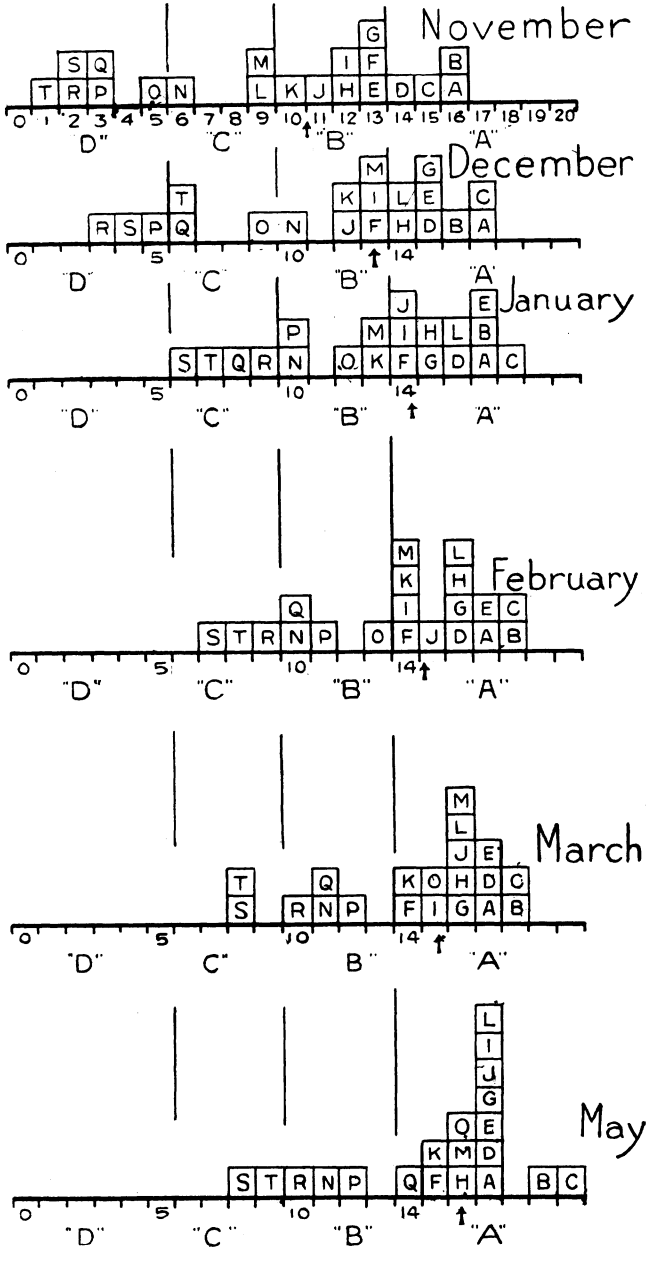


FIG. 1.—Distributions. Oral-reading rate. Lines per minute

needed types of instruction. *It will be remembered that class instruction is not shown* because it was the same for all. Only one lesson per week was devoted to class work as a rule.

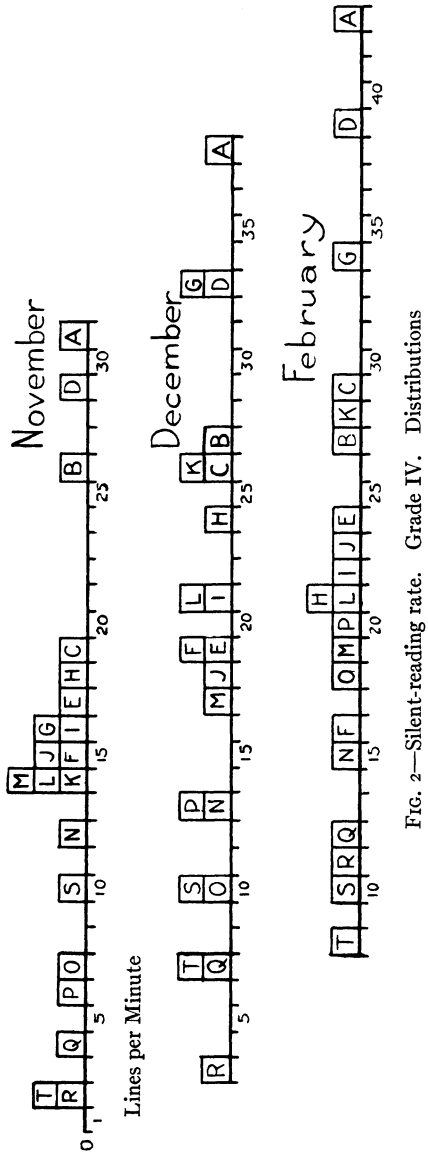


FIG. 2—Silent-reading rate. Grade IV. Distributions

The types of instruction most needed by pupils, whether good or poor readers, are types 3 and 4. Individual difficulties are very noticeable, especially in types 6 and 7. Types 1 and 2 are evidently very essential to poor readers; types 8 and 9 show the effect of previous training. Type 10 was needed by all but exceptionally facile readers, who instead kept a list of words which they wanted to look up in the dictionary and used the time given to the remainder of the class as a whole for that purpose.

The extent of reading evidently influences ability greatly. The rate, in turn, greatly limits the extent and the desire to read. These interrelations are suggested by Figs. 2, 5, and 6.

In Fig. 5 we notice that in October and November the average number of pages of silent supplementary reading per pupil during school hours was sixty, in December and January it was one hundred seventy-six, while in February and March it exceeded three

hundred pages. This graph is supplemented by Fig. 6, which shows the extent and quality of material read by individuals at home from October to April inclusive. These lists were accurately reported and include only reading matter which was done independently by the child. The influence of various types of extended reading is thus shown.

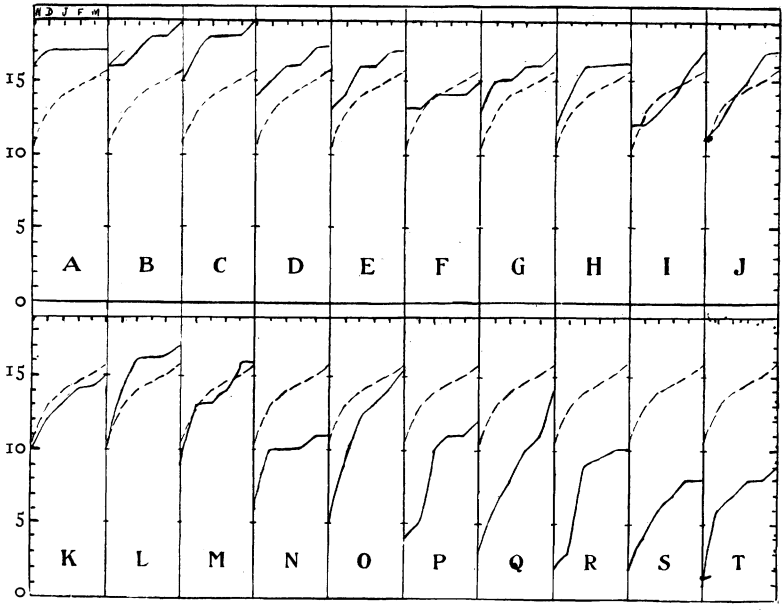


FIG. 3.—Individual records. Class medians. November–May

Thus E, who reads a great deal at home, has chosen such exciting and second-class material that it has been harmful rather than helpful. He evidently reads for the sensation derived. He has no taste for better material and is hard to interest except in competitive work. Type lessons 3, 4, and 6 were what he needed most (Fig. 4). He was the only fast reader whose articulation was poor. A great amount of absence, due largely to minor illnesses, makes his record incomplete, but suggests a possible correlation between emotional attitude and physical tone. Pupil F read a great deal, but most of his reading was very simple. He has a very active

Type 1–10	Pupil																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1. Flash phrasing			2	1	2	2	2	3	1	2	2	1	4	5	5	5	5	5	5	5
2. Eye habits	1	1	3	1	2	2	3	2	1	2	1	2	1	2	4	4	4	4	4	2
3. Silent for meaning	2	2	2	2	3	2	2	2	4	3	4	2	2	4	4	5	5	5	5	4
4. Silent search for given idea	2	3	2	2	3	2	3	2	4	3	4	2	2	3	4	5	5	5	5	4
5. Differentiation of words	1	1	1	1	2	2	2	3	2	1	1	4	2	3	2	4	4	4	5	4
6. Errors—omission-subs	1	1	2	1	4	4	1	4	3	1	1	5	1	1	1	2	4	2	5	2
7. Breath control						2	1	5			2			5	2	1	1	1	1	
8. Articulation					2					1		1	2	1	2	1		1	3	1
9. Voice and expression	1	1	1	1	1	3	1	1	3	1	1	1	1	1	3	1	2	2	1	2
10. Vocabulary word-study	2	3	2	2	2	2	2	3	2	3	3	2	3	3	3	3	2	3	3	2
Absence	3	2	3	1	3	2	2		3	1	1	3		1			2		1	3

Fig. 4.—Relative Amounts and Types of Individuated Instruction Given in Group Work

mind and home reading for him is a form of relaxation. His errors are due to his ability to forecast the probable outcome. He gets the meaning but changes unimportant words or omits them and often stops in the middle of a passage of oral or silent reading to give an opinion or relate an experience. He is very hard to handle in class instruction because of his highly developed associative habits of mind, but is without doubt a very promising pupil. When not reading for relaxation, his favorite book is an atlas or encyclopedia.

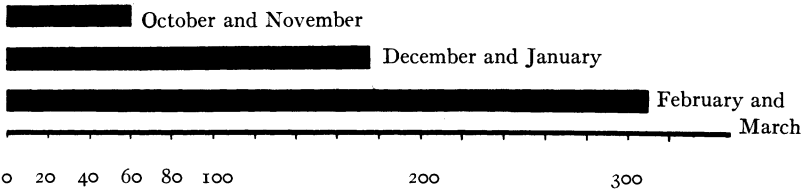
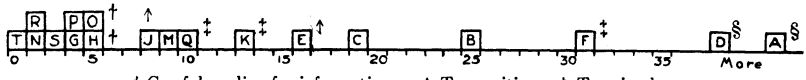


FIG. 5.—Average number of pages of silent reading per pupil (during school hours). Supplementary material.



† Careful reading for information. ↑ Too exciting. ‡ Too simple.
§ Very fine lists. Variety in content.

FIG. 6.—Report of home reading, October–April (number of books read)

Pupil H had a queer habit of not stopping for breaths, but gasping indistinct words on inhalations and reading clearly on exhalations. He got very little meaning from oral reading and if questioned would ask for permission to re-read silently for meaning. He had carried over his breathing habits from silent to oral reading, without making any readjustments. In free discourse his conversation was well intoned and pleasing. In reading he often emphasized the words which had no expression value. Type lesson 7 cleared up the whole matter.

The variation in the amounts of training and practice needed to correct similar faults in different pupils not only shows individual differences in native ability but also in mental inertia. Some pupils never knew their own powers because they had not been

roused, but allowed to putter away at a very low level of attention. This accounts for some very rapid improvement. A pupil who in three years of school life develops the ability to read only five lines per minute must tap new mental resources to triple his rate in four months (pupil O).

Other correlations are shown in Figs. 7 and 8. The base line is divided into twenty spaces lettered for the twenty pupils. The vertical is the achievement record. The degree of correlation is revealed by the similarity of the lines in each graph. For instance, the lines for oral and silent rate indicate a partial but significant

FIG. 7.—Oral reading. Oral reproduction

correlation. There seems to be an increase in individual variations as rate increases. Improvement in oral rate is not always coincident with improvement in silent rate.

There is no scale whereby the personal attitude toward reading can be measured, but measurement certainly does not appear to have had any detrimental effect on attitude, in this experiment.

One end of reading instruction is reading ability, but the greater aim is to formulate and foster the desire to read, by providing an ample supply of good supplementary material and an opportunity for individual selection and silent enjoyment.

The study has resulted in definite conclusions which will influence the writer's method of instruction. Most of the conclusions based on a study of the psychology of reading as stated in former pages were confirmed by experiment. The efficiency and

economy of instruction are very dependent on (1) individual diagnosis, (2) individual remedial work, (3) thorough analysis and regular measurement of individual improvement, (4) motivation, (5) provision for suitably graded extensive reading, (6) system in application of diagnostic tests and remedial work, (7) correct valuation and proportional stress on various types of reading,

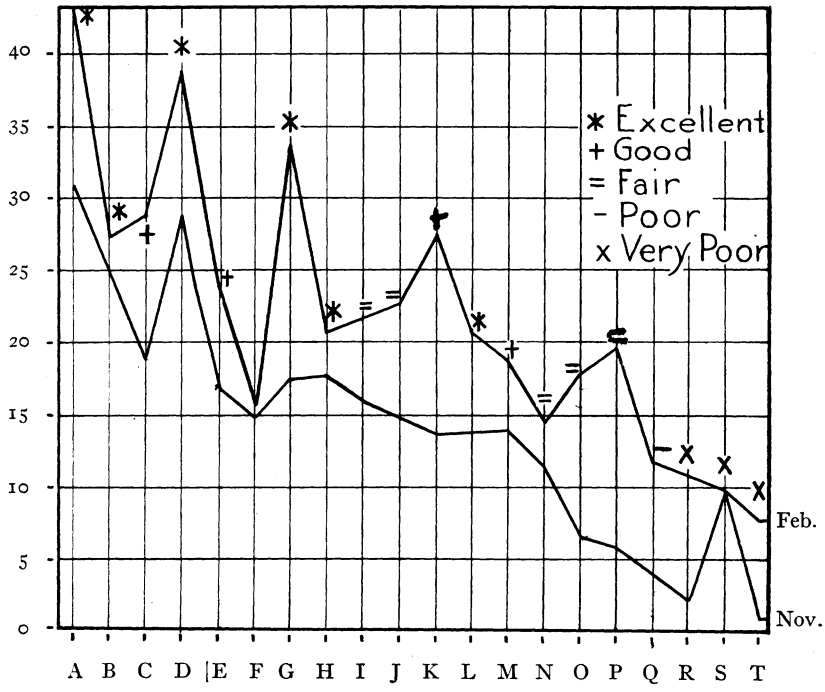


FIG. 8—Silent reading. Written reproduction. Relation of rate to quality

(8) a realization that *special* habits cannot be formed by *general* training and practice.

Several of the standard reading tests were applied in April and May to test the validity of methods employed by comparing results with norms and means. Unfortunately there are very few tests which can be applied more than once without losing their test value, on account of the effects of familiarity and practice. Other tests are designed primarily for supervisory rather than diagnostic

purposes and therefore are not so reliable for the measurement of individuals. Nevertheless available tests were applied and are submitted for what they may be worth in combination.

Class score, Gray oral-reading test	49.4	
Grade IV, Cleveland median score, Gray oral-reading test	47.22	
Grade IV, Cleveland average—all boys, Gray oral-reading test	45.	
Class score, median time to read 100 words silently	27.2	sec.
Cleveland Grade IV	34.5	sec.
Class median score, Kansas silent-reading test, comprehension	18.15	
Fourth-grade norm (1915–16)	9.4	

The class score in this test falls between the seventh- and eighth-grade norms. Eighty per cent of the class had scores higher than 12.5.

Individual scores were:

A	B	C	D	E	F	G	H	I	J	K
20.5	21.6	23.8	20.2	20.8	18.9	19.7	19.1	19	17.3	12.6

L	M	N	O	P	Q	R	S	T
21.6	16.1	14.6	14.2	6.1	13	2.9	6.8	2.6

THORNDIKE'S READING SCALE *A*: VISUAL VOCABULARY

Class score 6.09

Rank of individuals:	11	10	9	8	7	6	5
	A	D	B	G	C	E	R
				M	F	K	S
					H	N	T
					I	O	
					J	P	
					L	Q	

THORNDIKE'S SCALE ALPHA A

Class score 6 (understanding of sentences)

Rank of individuals:

8.41														5.13	4
C,	M,	D,	A,	J,	G,	E,	H,	I,	B,	N,	Q,	O,	K,	R,	S
			F					L						T	
														P	

The class score falls between L and B.

Eighty per cent of the class had scores above 5.25. The median time for tests 1, 2, 3, and 4 was 18 minutes.

The ten highest scores were made by pupils who used median time or less.

Pupil C was really not tested to his limit. He had a perfect score on one test usually given only to seventh- and eighth-grade pupils.

CLASS MEDIANS

Words per second, Horace Mann Reader IV:

Oral November	1.8+
Silent November	2.4+
Oral March	2.6+
Silent March	3.6+

Starch reading tests (for written reproduction):

Average words per second 2.59 (silent)

Average words reproduced from 30 seconds of reading 34.2

Oberholtzer and Courtis investigations resulted in a reading rate of 2.6 words per second silently. Starch fourth-grade average is 2.4 with a reproduction average of 28 words. Oberholtzer gives 2.3 words per second as a fourth-grade standard in oral reading. Differences may be due to purpose of reading, which influences rate.

The New Courtis Silent Reading Test, Form "B," was not applied until after the summer vacation and two months of further instruction.

The median scores were: Words per minute, 189.5 (per second, 3.16). Questions answered in 5 minutes, 42 (yes or no). Index of comprehension, 94 per cent.

A different set of habits or reactions is called forth for oral than for silent reading. Varying rates are desirable for various purposes. A preponderance of any one type of reading practice tends to lower the efficiency in neglected types, i.e., if careful reading is pursued to the exclusion of rapid silent reading for general appreciation, the reader will lose the ability to profit by rapidly scanning material of little value and selecting passages for careful reading. Both abilities are valuable and must be cultivated.

There is a point beyond which rate becomes insignificant as a measure of ability, but *silent* reading does not appear to be effective until a rate of 1.3 words per second or 80 words per minute is approximated in *oral* reading. At this point silent reading seems to free the attention from vocalization and permit an increase in the amount grasped at one glance. This in turn reacts on the

oral-reading rate. It is then important to cultivate proper habits of silent reading before a child is expected to use a textbook for silent study of informational matter. A silent-reading rate of less than 15 lines or 120 words per minute is unsatisfactory, and highly correlated with insufficient comprehension. Extensive reading cannot be expected from pupils who have not approximated this silent rate. These are not arbitrary convictions but rough estimates based on the experiment here recorded.

This study was not conducted by a specialist, but by a grade teacher interested in the advancement of the class through methods which reach the individual members. No time was taken from other studies. In fact a similar experiment in individuated instruction was simultaneously carried on in spelling, arithmetic, and penmanship. The results were tested and are evidence that no one subject was overstressed. The time economy, resulting from scientific procedure, also made possible a fulness and breadth of teaching usually thought incompatible with standardization and educational measurement.